DOCUMENT RESUME

ED 304 108 IR 013 667

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TITLE The Missing Link: A Bridge between Task Analysis and Training Strategy.
PUB DATE 7 Apr 88
NOTE 9p.; Paper presented at the Annual Meeting of the National Society for Performance and Instruction (Washington, DC, April 7, 1988).
PUB TYPE Guides - Non-Classroom Use (055) -- Viewpoints (120) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Classification; Design Requirements; Instructional Development; *Instructional Systems; Job Training; *Learning Strategies; *Needs Assessment; Skill Development; Systems Approach; *Systems Development; *Task Analysis; Training

ABSTRACT

This description of a method for using task analysis information to derive skill and knowledge requirements in the development of a training course begins by considering two important aspects of deriving skill and knowledge requirements. First, it is argued that task description is an important part of system design and training development in that it is concerned with attempts to identify the formal properties of performance, and to categorize them into their underlying components, i.e., skills and knowledge. Second, it is argued that a taxonomy for categorizing the skills and knowledge required should be used to analyze the components of work behavior in terms of the characteristics of the worker, and that training should be developed around the particular characteristics and capabilities of the learner population. A four-part classification scheme is then proposed for the types of jobs that evolve in large systems. The four categories of requirements--definitional, procedural, decisional, and heuristic requirements--are described, and it is noted that the task analyst or training developer must be taugth to examine each job four times, to consider each of the categories separately. Arguing that these categories are exhaustive yet easily trainable, and that they lead to suggestions for training, it is suggested that these categories will fulfill most training needs. A taxonomy worksheet is attached. (EW)

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THE MISSING LINK

A BRIDGE BETWEEN TASK ANALYSIS AND TRAINING STRATEGY

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APRIL 7, 1988
WASHINGTON, D.C.

SESSION NUMBER 84

IR013667

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HANDOUT

USING A TAXONOMY TO DERIVE SKILLS AND KNOWLEDGES FROM A TASK ANALYSIS AND ESTABLISH LEARNING STRATEGIES FOR COURSE DEVELOPMENT

INTRODUCTION

In the design of a system, a task analysis serves as the basis for several important processes, for example, job design, performance aid design, personnel selection, and derivation of skill and knowledge requirements for training. The following is a discussion on how a task analysis "feeds" the training development process, and more specifically, a method for using task analysis information to derive skill and knowledge requirements.

Two important aspects of deriving skill and knowledge requirements will be considered. First, because of the nature of a system design effort, skill and knowledge requirements are derived from task analysis information prior to the final design of a job. Several implications of this procedure will be discussed. Second, the question of the need for a taxonomy or classification scheme for the skills and knowledge derived will be considered.

DERIVING SKILL AND KNOWLEDGE REQUIREMENTS

Let's discuss why a task analysis is important. The task analysis process includes both that which has been termed "task description" and that which has been termed "task analysis". Task description is concerned with stating activities or outcomes of activities, and it is certainly an important part of system design and training development. Task analysis, however, is more critical to the derivation of skill and knowledge requirements, in that it is concerned with attempts to identify the formal properties of performance and thus, to classify performance in behavioral categories for which the optimum learning conditions are presumed to differ. Thus, the primary goal of a task analysis is to analyze activities and categorize them into their underlying components, i.e., skills and knowledges.

The importance of the task analysis activity cannot be overemphasized. While it is true that the task description lists the activities to be trained, it does not indicate how that training will best be achieved. That is, a learner does not directly learn to perform activities; rather, he or she learns the various skills and knowledge which comprise the activity. If training is to be efficient and effective, the learning situation must be structured in such a way that it best achieves the learning of the skills and knowledge.

IMPLICATIONS OF A SYSTEM DESIGN ENVIRONMENT

In system design, a task analysis is largely completed by the end of the design stage. This has several interesting implications. The work modules are not yet synthesized, which means that the training developer is in a system-wide, task-oriented environment. This can be detrimental to training development. The reliability of the task analysis data may suffer, since direct measures of job performance are unavailable. That is, the activity descriptions are based on tasks as they are designed, rather than on tasks as they have been performed. These activity descriptions are subject to change, misinterpretation, etc. To minimize this problem, we suggest following a well-defined set of procedures for conducting a task analysis and creating a job design with frequent testing of the design products and by getting feedback from the various design team members.

At the same time, beneficial effects of the system design environment occur. Since a task analysis is being performed for an entire system, there is an opportunity to look for requirements that may be common to all or some tasks in the system. All tasks, for example, may require certain basic knowledge of the system goals and operations. These can be analyzed and grouped together into orientation or indoctrination training. Or several tasks may require the common skills and knowledge of operating a piece of equipment, e.g., a teletypewriter. A single training course can be developed and administered to all system operators who share the common requirement. Thus, a certain efficiency in the training development for the total system is gained by virtue of the fact that a clear picture of all training requirements is available at one time. A plan for the development of training can take advantage of the commonalties that may exist through the development of the minimum number of training courses with the least overlap between them. Further efficiency, in terms of the total system, is achieved since these considerations also are important for job synthesis and personnel planning.

In summary, it appears reasonable to assume that the derivation of the skill and knowledge requirements that underlie an activity is a significant step in the development of training. While there are detrimental aspects involved in operating in a design environment, these may well be overshadowed by the benefits. It also seems reasonable that further benefits can be achieved by deriving skills and knowledge through a procedure that aids in the actual derivation of the skills and knowledge and that classifies the skills and knowledge in a way that will help in later stages of training development. This is the topic of the next section.

CLASSIFICATION OF SKILLS AND KNOWLEDGES

There are differences in opinion as to the criteria to be satisfied by a classification scheme or taxonomy for classifying skills and knowledge. After several unsuccessful attempts to produce a taxonomy with mutually exclusive categories, it was decided that mutual exclusiveness of terms may be, from an operational standpoint, a vainly sought after objective for a taxonomy. It is important, however, that the categories fit the specific training situation and lead to differential decisions regarding training. These are the criteria sought.

BENEFITS OF A TAXONOMY

Numerous taxonomies for classifying skills and knowledge, tasks, and other training requirements, have been produced. Among the more significant of these have been the schemes proposed by Gilbert, Miller, and Gagne. In addition, the taxonomy of educational objectives proposed by Bloom has been highly influential, especially in the more traditional educational environments. These taxonomies have generally had a similar, if not common, starting point. There has been an attempt to organize and analyze task information around knowledge (or at least hypotheses) about how the human mechanism organizes the information processing that goes on within itself. In other words, the analyses of the components of work behavior should be based on the characteristics of the worker. This is perhaps the chief benefit to be gained from a taxonomy. The resulting training will be developed around the particular characteristics and capabilities of the learner population.

At the same time, the large number of proposed taxonomies indicates that there is, as yet, no universally accepted scheme for classifying. This undoubtedly stems from the diversity of theories of how humans learn, as well as the different applications for which the taxonomies have been developed. The taxonomy described here, we feel, is extremely easy to understand and use. This taxonomy is simple enough to be used with a minimum of training, and yet, inclusive enough to encompass most training requirements.

THE TAXONOMY

The taxonomy we developed consists of four basic categories which are oriented to the types of jobs which evolve in large systems. The task analyst/training developer is taught to use the taxonomy by examining the task requirements of a job four times.

The classes or categories of requirements looked for on each examination are as follows:

1. Definitional Requirements.

   In this class we include, essentially, the terminology requirements for successful job performance. We further categorize definitional items into:

   A. Terms that must be MEMORIZED, i.e., those definitions which must be part of the worker's repertoire in order for successful performance to occur.

   B. Terms with which the worker must be FAMILIAR, i.e., those terms for which the exact meaning must be known, but for which a reference or performance aid will be available.

   C. Terms that must be UNDERSTOOD, i.e., exact meanings need not be known; rather, the worker will use a term at a higher conceptual level in the performance of the job.

2. Procedural Requirements.

   In this class we include activities performed in a step-by-step sequence. Procedures involve both skills and knowledge needed to support the performance. The procedures are generally of a psychomotor nature; thus, the training for procedure predominantly involves modeling and practicing.

3. Decisional Requirements.

   In this class we include situations where discriminations or generalizations must be made before proceeding to the next step in the process. The potential alternatives are known in advance, so that this type of requirement is essentially one of following an algorithm. Training for this requirement consists of recognition and identification of the situations and alternatives involved, as well as actions contingent upon recognition or identification. This requires training on both class inclusion and class exclusion.

4. Heuristic Requirements.

   We use heuristics in the classical sense as a way of coping inventively or improvisionally with unique events, requirements, and combinations of ignorance and knowledge. In this sense, heuristics cannot be directly trained since they cannot be directly planned for. Rather, this requirement represents an overall attitude or ability which is best achieved through the type of mutual discovery training provided for in seminars,

workshops, etc., which hope to teach general principles that can be transferred to many different situations. This type of requirement applies predominantly to less well-defined jobs, such as system administrators, system analysts, troubleshooting maintenance personnel, etc.

SUMMARY

We feel that these categories will fulfill most training needs. They are exhaustive of the kinds of requirements that occur. They are straightforward enough to be easily trainable and they do lead to suggestions for training. We feel that this taxonomy does represent a promising approach to analyzing skill and knowledge requirements and it does provide the course developer with insights for developing learning strategies later on.

TAXONOMY WORKSHEET

SKILLS - KNOWLEDGES	ENTRY LEVEL? (Yes/No)	ALTERNATIVES TO ACHIEVING PERFORMANCE	CLASSIFICATION 1. Definition a. Memorization b. Understanding c. Familiarization 2. Procedure 3. Decision 4. Following Principles